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# Environmentally Extended Input-Output Table for Switzerland 2008 - Eutrophication Potential (Nitrogen Footprint)

## factsheet

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## Imprint

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## Environmentally Extended Input-Output Table

An input-output table (IOT) depicts the economic transactions between the different sectors and the final demand of a country and serves as an important instrument in empirical analyses. The monetary IOT can be extended with data on the pollutant emissions and resource uses of the individual economic sectors and the final demand to yield an environmentally extended input-output table (EE-IOT). The EE-IOT allows, among other things:

- the identification of key sectors and activities responsible for environmental impacts,
- the assessment of the economic and environmental impacts of a certain consumption pattern and
- the development of policies to proceed towards a more sustainable economy.

In the present project, an EE-IOT was estimated for the Swiss economy in the year 2008 with a special focus on the energy, transportation, agricultural and food sectors. The resulting EE-IOT is made available to the public and can be used for further analyses. In this factsheet, the eutrophication potential caused by the Swiss economy is evaluated.

## Eutrophication Potential

The anthropogenic interference with the global nitrogen cycle by the industrial (Haber-Bosch process) and agricultural (leguminous crops) fixation of atmospheric nitrogen was identified as one of the planetary boundaries that has been already clearly transgressed (Rockström et al. 2009). The fraction of reactive nitrogen, which enters the environment, may affect water quality and the composition of aquatic and terrestrial ecosystems.

Marine eutrophication is caused by emissions of nitrogen compounds to air, water and soil and typically results in algal blooms, which are followed by oxygen depletion in the water and other adverse ecological effects. The fraction of the total nitrogen emissions ending up in the marine environment (i.e., the fate factor in units of year/km<sup>3</sup>) is estimated by the CARMEN model. The eutrophication potential, as defined in the ReCiPe 2008 impact assessment method, is then determined by the sum of all nitrogen fluxes to the environmental compartments multiplied by their respective fate factor (Goedkoop et al. 2009).

The eutrophication potential can be used to estimate the amount of algal biomass produced by the additional nitrogen input. This is an upper boundary since the growth of algae also depends on the season and other factors. The extent of oxygen depletion in the seawater can be derived from the mass of algae, but it is not possible to make a prediction about the consequences on other species (Goedkoop et al. 2009).

## Domestic and Foreign Eutrophication Potential

An overview of the total domestic and foreign eutrophication potential caused by Switzerland is given in Tab. 1. The Swiss domestic eutrophication potential amounts to 80.1 kt N-eq. A fraction of 29 % (23.0 kt N-eq) thereof is related to the production of exported goods and services. The Swiss domestic final demand, i.e. consumption of private households, the government, non-profit institutions and capital formation, results in a eutrophication potential of 116 kt N-eq in Switzerland and abroad. Hence, a fraction of 51 % (59.1 kt N-eq) of the total eutrophication potential ultimately related to Swiss consumption is caused abroad. The net traded eutrophication potential, defined as the difference between emissions of nitrogen compounds abroad caused by domestic final demand and domestic emissions caused by exports, is 36.1 kt N-eq.

Tab. 1 Domestic and foreign eutrophication potential caused by Swiss domestic final demand and by exports.

		Eutrophication potential		
		Domestic emissions	Emissions abroad	Total emissions
		t N-eq	t N-eq	t N-eq
Emissions caused by domestic final demand		57'110	59'093	116'203
Emissions caused by exports		23'022		
<b>Total</b>		80'132		
Net traded emissions				36'072

## Important Contributors to Domestic Eutrophication Potential

The ten most important contributors to the total domestic eutrophication potential are listed in Tab. 2. Only direct emissions of nitrogen compounds by households and industry sectors are considered for the identification of the ten most important contributors to the eutrophication potential. A share of 89 % of the domestic emissions of nitrogen compounds is caused by the ten economic sectors with the highest contribution.

The sector sewage and refuse disposal (g90c), which encompasses the wastewater treatment plants, is responsible for 24 % of the domestic eutrophication potential. Eight of the remaining sectors in the ten most important contributors to the eutrophication potential are agricultural subsectors. Livestock farming (g01o, g01k and g01p) is responsible for almost one third of the total domestic eutrophication potential, with dairy cattle being of particular importance with a share of 20 %. The production of food cereals (g01a) and feed crops (g01b) causes 15 % and 12 % of the total domestic eutrophication potential, respectively.

Industry and service sectors are not among the ten most important contributors to Switzerland's total domestic eutrophication potential, with the exception of the leather industry (g19).

Tab. 2 The ten most important contributors to the total domestic eutrophication potential. Only direct emissions by households and economic sectors are taken into account.

			Eutrophication potential t N-eq	Share in total
1.	g90c	Other sewage and refuse disposal, sanitation, similar activities	19'362	24%
2.	g01o	Dairy cattle and raw milk	15'676	20%
3.	g01a	Food cereals	11'917	15%
4.	g01b	Feed cereals	9'761	12%
5.	g01k	Non-dairy cattle	5'991	7%
6.	g01d	Root and tuber crops	2'229	3%
7.	g01p	Other animal products	1'952	2%
8.	g01e	Vegetables	1'949	2%
9.	g19	Tanning and dressing of leather and manufactures thereof	1'518	2%
10.	g01c	Sugar crops	1'118	1%
		Remaining contributors	8'658	11%
	<b>Total</b>		<b>80'132</b>	<b>100%</b>

## Nitrogen Footprint: Eutrophication Potential due to Final Consumption

The domestic and foreign eutrophication potential attributable to Switzerland from the consumption perspective (nitrogen footprint) can be shown by final consumption category and by product group.

The nitrogen footprint by consumption category is shown in Tab. 3. The consumption of private households causes 83 % of the total eutrophication potential related to Swiss consumption. The dominant category of household consumption with respect to the emissions of nitrogen compounds is food and non-alcoholic beverage (c01) with a share of 50 %. Capital formation is responsible for 10 % of the consumption related eutrophication potential and the consumption of the government and of non-profit institutions causes 8 %.

Domestic emissions and emissions abroad have a similar share in total eutrophication potential from the consumption perspective. Consumption categories with particularly high shares of eutrophication potential caused abroad are clothing and footwear (c03) with 89% of total emissions, household equipment and maintenance (c05) with 85% as well as alcoholic beverages, tobacco and narcotics (c02) with 80%.

Tab. 3 Disaggregation of the nitrogen footprint by consumption category: Eutrophication potential in Switzerland and abroad caused by consumption of private households, the government and non-profit institutions as well as by capital formation. The consumption of private households is further divided into twelve categories (c01 to c12).

			Eutrophication potential			
			Domestic emissions	Emissions abroad	Total emissions	Share in total
			t N-eq	t N-eq	t N-eq	
Consumption of private households			45'655	50'398	96'053	83%
	c01	Food and non-alcoholic beverage	28'605	29'064	57'668	50%
	c02	Alcoholic beverages, tobacco and narcotics	511	1'902	2'413	2%
	c03	Clothing and footwear	193	1'607	1'800	2%
	c04	Housing and energy	4'775	2'163	6'938	6%
	c05	Household equipment and maintenance	240	1'337	1'577	1%
	c06	Health	2'769	2'356	5'124	4%
	c07	Transport	1'439	1'319	2'758	2%
	c08	Communications	122	215	336	0%
	c09	Recreation and culture	1'679	4'823	6'501	6%
	c10	Education	103	79	182	0%
	c11	Restaurants and hotels	4'439	4'073	8'512	7%
	c12	Misc. goods and services	782	1'461	2'243	2%
Consumption of the government and non-profit institutions			6'310	2'478	8'788	8%
Capital formation			5'145	6'217	11'362	10%
<b>Total domestic final consumption (excl. exports)</b>			<b>57'110</b>	<b>59'093</b>	<b>116'203</b>	<b>100%</b>

In a second analysis the contribution of the most important product groups to the consumption related eutrophication potential is shown. Tab. 4 shows the ten product groups, which cause the highest total eutrophication potential with a disaggregation into domestic emissions and emissions abroad. They cover a share of 58 % of the total eutrophication potential caused by Swiss consumption.

Eutrophying emissions hardly occur during final consumption. This is mainly due to the fact that all households are linked to sewage treatment plants. In general food products cause a large share of emissions. Processed meat (g15a) is the product group with the highest share of the eutrophication potential (15% of the total). Dairy products (g15e) follow with a share of 11%. In both cases emissions mainly stem from agriculture and domestic emissions dominate. Hotel and restaurant services (g55) then follow with a share of 8%. Product groups with a particular large share of emissions abroad are bakery and farinaceous products (g15g) and other food and tobacco products (g15jp16) with a share of 85 % of the total eutrophication potential occurring abroad.

Tab. 4 Disaggregation of the nitrogen footprint by product group: Eutrophication potential in Switzerland and abroad caused by Swiss consumption.

			Eutrophication potential			
			Domestic emissions	Emissions abroad	Total emissions	Share in total
			t N-eq	t N-eq	t N-eq	
1.	g15a	Processed meat	10'595	7'145	17'741	15%
2.	g15e	Dairy products	9'929	3'019	12'948	11%
3.	g55	Serv. of hotels and restaurants	4'847	4'426	9'273	8%
4.	g15g	Bakery and farinaceous products	1'107	6'375	7'481	6%
5.	g85	Health and social work services	3'442	2'576	6'018	5%
6.	g90c	Disposal services	5'722	61	5'783	5%
7.	g45	Construction services	3'228	1'969	5'197	4%
8.	g15jp16	Other food products, tobacco products	646	3'578	4'224	4%
9.	g15f	Grain mill and starch products	2'393	1'772	4'165	4%
10.	g80	Education services	1'733	1'328	3'061	3%
		Remaining product groups	13'468	26'844	40'312	35%
		<b>Total</b>	57'110	59'093	116'203	100%

## Conclusions and Outlook

The consumption of Switzerland results in a eutrophication potential of 116 kt N-eq in 2008, of which 59.1 kt N-eq (51 %) are caused abroad and associated with imported goods and services. Agriculture is the most important direct contributor to the total eutrophication potential caused in Switzerland. Food products have a high share in the total nitrogen footprint from the consumption perspective. The sector sewage and refuse disposal is of high importance from the production perspective (domestic emissions of nitrogen compounds) but much less from the consumption perspective (domestic and foreign emission). The environmentally-extended input-output table makes it possible to identify the key economic sectors and products ultimately responsible for the domestic and foreign eutrophication potential caused by Swiss consumption.

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